Second, its mountains trend east and west, from the Pyrenees to the Carpathians and the Caucasus beyond, near its southern border; and they had glaciers of their own, which must have begun their operations, and poured down the northward flanks, while the plains were still covered with forest on the retreat from the great ice-wave coming from the north. Attacked both on front and rear, much of the forest must have perished then and there. Third, across the line of retreat of those which may have flanked the mountain-ranges, or were stationed south of them, stretched the Mediterranean, an impassable barrier. Some hardy trees may have eked out their existence on the northern shore of the Mediterranean and the Atlantic coast. But we doubt not, taxodium and sequoias, magnolias and liquidambars, and even hickories and the like were among the missing. Escape by the east, and rehabilitation from that quarter until a very late period, was apparently prevented by the prolongation of the Mediterranean to the Caspian, and thence to the Siberian ocean."

Prof. Gray shows that on the American continent on the other hand the trees, when touched in the north by the incoming refrigeration, had only to move their southern border southward, along an open way, as far as the exigency required; and there was no impediment to their due return. The still greater richness of north-east Asia in arboreal vegetation may find an explanation in the prevalence of particularly favourable conditions, both anteglacial and recent.

"The case of the Pacific forest is remarkable and paradoxical. It is, as we know, the sole refuge of the most characteristic and wide-spread type of miocene coniferæ, the sequoias; it is rich in coniferous types beyond any country except Japan; in its gold-bearing gravels are indications that it possessed, seemingly down to the very beginning of the glacial period, magnolias and beeches, a true chestnut, liquidambar, elms, and other trees now wholly wanting to that side of the continent, though common both to Japan and to Atlantic North America. Any attempted explanation of this extreme paucity of the usually major constituents of forest, along with a great development of the minor, or coniferous, element, would take us quite too far, and would bring us to mere conjectures."

Prof. Gray concludes his interesting lecture by saying:—

"I have done all that I could hope to do in one lecture if I have distinctly shown that the races of trees, like the races of men, have come down to us through a prehistoric (or pre-natural-historic) period; and that the explanation of the present condition is to be sought in the past, and traced in vestiges, and remains, and survivals; that for the vegetable kingdom also there is a veritable archæology."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE Cambridge Smith's Prizes have been awarded to Micaiah John Muller Hill, B.A., St. Peter's College, and Arnold Joseph Wallis, B.A., Trinity College, bracketed equal. These gentlemen were also bracketed equal as fourth wranglers in 1879.

A UNIVERSITY for ladies will be opened shortly in Odessa. It will have three faculties—History and Literature, Mathematics, and Natural Science. The programme will be the same as in the other Russian Universities for male students, with a few changes. Greek will not be obligatory in the Historico-Literary Faculty; there will be in the same faculty a Chair of Political Economy and Statistics. Pedagogy and hygiene will be obligatory in all faculties.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 12, 1878.—In an inaugural dissertation here given, Herr Nahrwold studies atmospheric electricity; his method of experiment having been to electrify air in a cylindrical vessel fitted with a (mercury) dropping collector. His first attempts, with points, convinced him that only the dust, not the air, could be thus electrified; he then successfully used a fine platinum wire kept glowing with a battery (the air having been first freed from dust), and a condenser or galvanic element connected with the circuit. Interesting data are furnished with regard to the charge of the air, the ratio of this to the source of electricity used, and the decrease of the charge. Some of the observations seem to throw doubt on Thomson's conclusions as to the distribution of electricity in the upper regions of the atmosphere.—Herr Wiedemann offers a theory on the nature of spectra, deduced from the kinetic theory of gases. Line-spectra are attributed to oscillatory motions of atoms, isolated at high temperatures; band spectra of elements and spectra of compounds to vibrations of atoms in the molecule, or of the ether-envelopes.—A quantitative verification of the electrodynamic law, regarding the reciprocal action of closed circuits, for the case in which the circuit suffers deformation, is furnished by Herr Niemöller.—Herr Korteweg discusses the velocity of propagation of sound in elastic tubes, and Herr Rühlmann gives formulæ for measurement of ocean depths with the manometer.—There are several notes on crystallography.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 23.—"Researches on Lactin," by Edmund J. Mills, D.Sc., F.R.S., "Young" Professor of Technical Chemistry in Anderson's College, Glasgow, and James Hogarth.

The authors have investigated lactin with the aid of polarised light, their object being to gain further insight into the chemical nature of that compound. Their conclusions are as follows:—

1. The initial specific rotation of lactin is 92°·63.
2. The permanent specific rotation of lactin is 59°·17.
3. The change of rotation of a solution of lactin can be expressed by a mathematical equation.
4. When the specific rotation 64°·8 is reached, the law of change must be expressed by a different equation.
5. The initial solubility of lactin is one part lactin in 10·64 parts water.
6. The permanent solubility is one part lactin in 3·23 parts water.

"Researches on Chemical Equivalence." Part II. Hydric Chloride and Sulphate. By Edmund J. Mills, D.Sc., F.R.S., and James Hogarth.

While carrying out their researches on lactin, it struck the authors that use might be made of it to compare the dynamical equivalents of acid bodies. They accordingly selected hydric chloride and hydric sulphate for the measurements in question.

The results show that though 2HCl may be the "equivalent" of H_2SO_4 in weight for saturation (*i.e.*, in the ordinary sense), it certainly is not the equivalent in the dynamical sense. They also render it highly probable that HCl is equal dynamically to H_2SO_4. Ostwald, by a method based on the alteration of the specific volume of solutions, has shown that the ratio $\frac{2HCl}{H_2SO_4} = 1{\cdot}93$, a result which their numbers, though not as perfect as the authors could wish, nevertheless strongly confirm.

"Limestone as an Index of Geological Time," by T. Mellard Reade, C.E.

January 30.—"On Certain Means of Measuring and Regulating Electric Currents." By C. William Siemens, D.C.L., F.R.S.

The dynamo-electro machine furnishes us with a means of producing electric currents of great magnitude, and it has become a matter of importance to measure and regulate the proportionate amount of current that shall be permitted to flow through any branch circuit, especially in such applications as the distribution of light and mechanical force.

On June 19 last, upon the occasion of the *soirée* of the President of the Royal Society, was exhibited a first conception of an arrangement for regulating such currents, which the author has since worked out into a practical form. At the same time a method has been realised by which currents passing through a circuit, or branch circuit, are measured, and graphically recorded.

It is well known that when an electric current passes through a conductor heat is generated, which, according to Joule, is proportionate in amount to the resistance of the conductor, and to the square of the current which passes through it in a unit of time, and advantage has been taken of this well-established law of electro-dynamics, in order to limit and determine the amount of current passing through a circuit.

The paper refers to three instruments, in the first of which one end of a thin strip of metal is attached to a screw, by which its tension can be regulated; it then passes upwards over an elevated insulated pulley, and down again to the end of a short lever working on an axis, armed with a counter-weight and with a lever whose angular position will be materially affected by any small elongation of the strip that may take place from any cause. The apparatus further consists of a number of prisms of metal, supported by means of metallic springs, so regulated by movable weights as to insure the equidistant position of each prism from its neighbour.

A series of comparatively thin coils of wire of German silver or other resisting metal, connect the alternate ends of each two adjoining springs, the first and last spring being also connected to the lever and terminal respectively.

The strip is put under a glass shade, and the instrument itself should be placed in a room where a tolerably uniform temperature of say 15° C. is maintained.

When the minimum current is passing, the thin metallic strip is at its minimum working temperature, and all the metallic prisms are in contact, this being the position of least resistance. As soon as the current passing through the apparatus shall increase in amount, the thin metallic strip will immediately rise in temperature, which will cause it to elongate, and will allow the lever to recede from its extreme position, liberating one contact piece after another. Each such liberation will call into action the resistance coil connecting the spring ends, and an immediate corresponding diminution of the current through the additional resistance thus thrown into the circuit.

Suppose that the current intended to be passed through the instrument is capable of maintaining the sensitive strip at a temperature of say 60° C., and that a sudden increase of current takes place in consequence either of an augmentation of the supply of electricity or of a change in the extraneous resistance to be overcome, the result will be an augmentation of temperature, which will continue until a new equilibrium between the heat supplied and that lost by radiation is effected. If the strip is made of metal of high conductivity, such as copper or silver, and is rolled down to a thickness not exceeding 0·05 millim., its capacity for heat is exceedingly small, and its surface being relatively very great, the new equilibrium between the supply of heat and its loss by radiation is effected almost instantaneously. But, with the increase of temperature, the position of the regulating lever is simultaneously affected, causing one or more contacts to be liberated, and as many additional resistance coils to be thrown into circuit: the result being that the temperature of the strip varies only between very narrow limits, and that the current itself is rendered very uniform, notwithstanding considerable variation in its force, or in the resistance of the lamp, or other extraneous resistance which it is intended to regulate.

The resistance coils, by which adjoining contact-springs are connected, may be readily changed, so as to suit particular cases; they are made by preference of naked wire, in order to expose the entire surface to the cooling action of the atmosphere.

For feeble currents, disks of carbon are substituted for the wire rheostat, the electrical resistance of carbon varying inversely with the pressure to which it is subjected. A steel wire of say 0·3 millim. diameter is drawn tight between the end of a bell-crank lever and an adjusting screw, the pressure of the lever being resisted by a pile of carbon disks placed in a vertical glass tube. The current, passing through the steel wire, through the bell-crank lever, and through the carbon disks, encounters the minimum resistance in the latter so long as the tension of the wire is at its maximum; whereas the least increase in temperature of the steel wire by the passage of the current causes a decrease of pressure upon the pile of carbon disks, and an increase in their electrical resistance; it will thus be readily seen that, by means of this simple apparatus, the strength of small currents may be regulated so as to vary only within certain narrow limits.

The apparatus first described may be adapted also for the *measurement* of powerful electric currents. The variable rheostat is in this case dispensed with, and the lever carries at its end a pencil pressing with its point upon a strip of paper drawn under it in a parallel direction with the lever by means of clockwork. A second fixed pencil draws a second or datum line upon the strip, so adjusted that the lines drawn by the two pencils coincide when no current is passing through the sensitive strip. The passage of a current through the strip immediately causes the pencil attached to the lever to move away from the datum line, and the distance between the two lines represents the temperature of the strip. This temperature depends, in the first place, upon the amount of current passing through the strip, and, in the second place, upon the loss of heat by radiation from the strip; which two quantities balance one another during any interval that the current remains constant.

In order to facilitate the process of determining the value of the diagram produced by motion of pencil in Weber's or other units of current, it is only necessary, if the variations are not excessive, to average the ordinates, and to determine their value from a table prepared for that purpose. The error committed in taking the average ordinate instead of the absolute ordinates, when the current varies between small limits, is evidently small, the variation of the ordinates above their mean value averaging the variations below the same.

The thin sensitive conductor may thus be utilised either to restrict the amount of electricity flowing through a branch circuit, within certain narrow limits, or to produce a record of the amount of current passed through a circuit in any given time.

Physical Society, January 25.—Prof. G. C. Foster, vice-president, in the chair.—Prof. E. Ray Lankester and Mr. Alex. Macdonald, B.A., were elected Members.—Dr. Erck exhibited a constant bichromate of potash battery. The ordinary bichromate battery soon loses power when in use, and in order to secure a powerful constant battery to drive a small astronomical clock, Dr. Erck devised the modified form shown. It consists of a narrow lead trough 12 inches long by 3 inches wide and 1 inch deep, lined along both sides with two carbon plates. The zinc plate 10 inches long is immersed in the solution to the depth of an inch midway between the two carbons. A continual circulation of the bichromate solution is kept up by allowing fresh solution to drop into the cell at one end, and the exhausted solution to drop away by a tap at the other end. As the space between the two carbons is only about half an inch wide, there is merely a thin layer of solution between the positive and negative poles. The internal resistance of the cell is, therefore, very low, when short circuited only about $\frac{1}{4}$ ohm. To obtain the maximum current about 8 oz. of solution per hour should be applied. Dr. Erck also showed a battery formed of zinc and carbon circular plates mounted on an axle which is rotated by wheelwork, thus mechanically stirring the bichromate solution.—Dr. F. Guthrie, F.R.S., described some of the results he had obtained from experiments on the vibration of metal rods or lathes fixed in a vice at one end and free to vibrate at the other. The experiments were carried on by dusting sand on the rod and observing the nodal lines formed by it when the rod was vibrated, so as to give out notes determined by a monochord. Dr. Guthrie's results show that the two final segments at the free end are together equal in length to the inner segment at the fixed end. It appears from these experiments that if a free lathe vibrating with a node in the middle, but having an even number of segments, be clamped at where there is a node, we alter its conditions of vibration. When the lathe is half free, the end segment breaks up into two parts together equal to the segment at the fixed end. In the case of a torsional vibration of the lathe, the position of the longitudinal nodal lines depended to some extent on the clamping of the lathe in the vice. Prof. Foster pointed out that in a natural node the direction of the tangent is varying, whereas in an artificial node it is always horizontal. Prof. Unwin explained that the sand accumulated at nodes because the particles, when thrown off the lathe, make certain horizontal excursions which tend to move them nearer the points of repose of the lathe.—Messrs. Elliot Brothers exhibited sundry electric commutators and resistance boxes.

Anthropological Institute, January 21.—Mr. John Evans, D.C.L., F.R.S., president, in the chair.—The Director read a communication from Dr. Paul Topinard on resemblances between a Galtcha and a Savoyard skull. The similarity between these skulls is such that the author is inclined to regard the Galtchas of Eastern Turkistan and the Celts of Western Europe as branches of one common stock, of which the Slavs of Eastern Europe are also members.—M. Elie Reclus read a paper on circumcision, its significance, its origin, and its kindred rites. The practice of this custom was traced over a large portion of the inhabited globe, including Australia and South America, though among the nations of antiquity the Egyptians and Jews are those among whom it is best known to have prevaile .

Photographic Society, January 14.—James Glaisher, F.R.S., in the chair.—Capt. Abney, R.E., F.R.S., read a paper on the fading of the undeveloped photographic image, and on soluble bromide in emulsions; and Col. Wortley explained a new instantaneous shutter, designed by him. Capt. Abney, in his paper, stated that one cause of the fading arose from impure pyroxyline, which, during decomposition, liberated nitrous acid; and that this acid would destroy (before development) a photographic image on collodion, made from such pyroxyline.—Capt. Abney then discovered that as an excess of alkaline bromide would not diminish sensitiveness, or rather not prevent an image being formed, consequently, if a nitrite of some alkali, in conjunction with an excess of bromide, were added, the formation of any acid would be prevented, so that by the application of an alkaline carbonate to the film, all nitrous acid liberated from pyroxyline is absorbed to form an alkaline nitrite, and the destruction of the photographic image avoided.

CAMBRIDGE

Philosophical Society, December 2, 1878.—Prof. Liveing, president, in the chair.—Dr. G. W. Royston-Pigott made a communication to the Society on a new method of determining the limits of microscopic vision. The author referred to his method of forming miniatures by reversing an object-glass which has been described in the *Philosophical Transactions*, and showed how he had applied it to determine the limit of smallness of objects that could be detected by the microscope. The process employed was to form a miniature of an object such as a spider-line, and then examine the miniature with the microscope. In this manner Dr. Royston-Pigott had found that objects even as small as the millionth of an inch in diameter could be seen, contrary to the generally received view of opticians that it was useless to attempt to perfect the microscope further, as it could not show objects smaller than the hundred-thousandth of an inch in diameter. Dr. Jurin found that with the naked eye he could discover a pin fixed in a window forty feet away from him, subtending an angle of two or three seconds, but if he placed two pins together he could not distinguish them as separated except they were so far apart as to make an angle of forty seconds. Thus a bright interval could not be discovered unless it were ten or fifteen times larger than the objects forming it; but Dr. Royston-Pigott found that the excellence of modern objectives was such as to enable the eye to discern an interval only four times larger than the diameter of the web miniature, reckoned at one millionth of an inch. The microscopes and apparatus employed to produce the miniature were exhibited to the Society, and the precautions to be taken in the use of the method were explained.—Mr. W. M. Hicks communicated some results of an investigation on the motion of two cylinders surrounded by fluid.

PARIS

Academy of Sciences, January 27.—M. Daubrée in the chair.—The following papers were read:—Third reply to M. Berthelot, by M. Pasteur.—On the development of the perturbative function where, the excentricities being small, the mutual inclination of the orbits is considerable, by M. Tisserand.—On a formula giving approximately the moment of torsion, by M. de Saint-Venant.—Researches on the relations of spectrum analysis to the spectrum of the sun, by Mr. J. Norman Lockyer.—On the electric clutch-gear on board ships, by MM. Trève and Achard. An arrangement for managing marine engines or helms at a distance electrically.—On the composition of banana and attempts at utilisation of this fruit, by MM. Marcano and Muntz. The banana keeps the ground moist round it, and this property is utilised in Venezuela to help the coffee-plant in dry weather. But only a little of the banana's fruit is there used, and the authors call attention to the flour and the alcohol obtainable from it, recommending exportation. The flour is a food essentially feculent.—On the application of his atomic theory to various minerals, by M. Gaudin.—On the diameters of the sun and of Mercury, deduced from the transit of May, 1878, by M. Cruls (Rio de Janeiro). The solar semi-diameter is found 15′ 59″·982, agreeing nearly with Leverrier's 16′ 0″·0 (deduced from previous transits). The value for the planets' diameter, got from observations of ingress, was 10″·78, by another method 10″·74.—Hydro-electricity and hydro-magnetism; analytical results, by M. Bjerknes.—On a development in series, by M. Picard.—Displacement of spectral lines due to motion of rotation of the sun, by M. Thollon. His experiments on this with his new prism convince him that with a suitable arrangement the displacement may be produced in an incontestable manner. The telluric lines did not show any change, and some of them, near those of nickel, enabled one to see very distinctly how the latter were displaced.—On the radiation of incandescent platina, by M. Violle. He measured this from 900 to 1,775 degrees. The intensity of a given radiation does not increase indefinitely with the temperature, but passes through a maximum and then decreases to a point, where it becomes insensible. The luminous heat of fused platinum transmitted through alum is $\frac{1}{4\cdot5}$ of the total heat transmitted through rock-salt.—On the illumination of lines of molecular pressure, and on the trajectory of molecules, by Mr. W. Crookes. M. Du Moncel said the dark space is not only manifested in vacuo; it is distinctly seen round the negative electrode, on sending an induction spark between two plates of glass, and examining it with a microscope. (A figure is given.)—On electrodynamic phenomena, and especially on induction, by M. de Meaux. In a closed circuit, you do not change the intensity of the current produced by induction of an indefinite cylindrical conductor on another of the same form, by surrounding one or other, or even both, of these conductors with a concentric metallic envelope, communicating with the ground throughout its length.—On a new Bell telephone speaking with loud voice, by M. Gower. The two magnet poles are placed opposite each other; the diaphragm is thick, large, and tense; the inclosing case is metallic and sonorous, and a speaking trumpet is added.—On the amalgams of chromium, manganese, iron, cobalt, and nickel, and on a new process of preparation of metallic chromium, by M. Moissan. This method is, stirring a concentrated solution of protochloride of chromium in water with pasty sodium-amalgam; the amalgam of chromium obtained is then heated to 350° in a current of hydrogen. Amalgams of the other metals named may be had similarly.—On a preparation of methylformic ether and of pure methylic alcohol, by MM. Bardy and Bordet.—On the principles which give *Sarracenia purpurea* its therapeutic properties, by M. Hetet.—On the termination of the visceral arterioles of *Arion rufus*, by M. Jourdain.—Researches on the action of *grenat*, or the residue of the manufacture of fuchsine, by M. Jousset de Bellesme. This is used to colour wines. It may be taken in large quantities without causing death; but it is hurtful, producing uræmia, &c.—On the quantity of light lost in actuating the visual apparatus, and its variations under different conditions, by M. Charpentier. A light being gradually increased from zero, you note when the eye perceives it; it may then be reduced considerably without the eye ceasing to perceive it. This difference is much greater, if the eye have been kept in the dark five minutes or more. But this effect of rest in the dark does not apply (or very little) to chromatic sensibility. The author considers the sensation of light wholly independent of that of colour.—On the phosphorescence of the lobster's flesh, by MM. Bancel and Husson. They consider it due to a kind of fermentation.—M. Mége Mouris presented a note on the properties of marine salt; and MM. Nasse and Decharme, notes on a liquid rain which lately covered the ground with a thick surface of ice.

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